Communications Satellites: The Canadian Experience

Above: NASA launched Canada's newest communications satellite, Anik B, on December 15, 1978.

NASA

Cover: Sails covered with solar cells provide power for both HERMES and Anik B.

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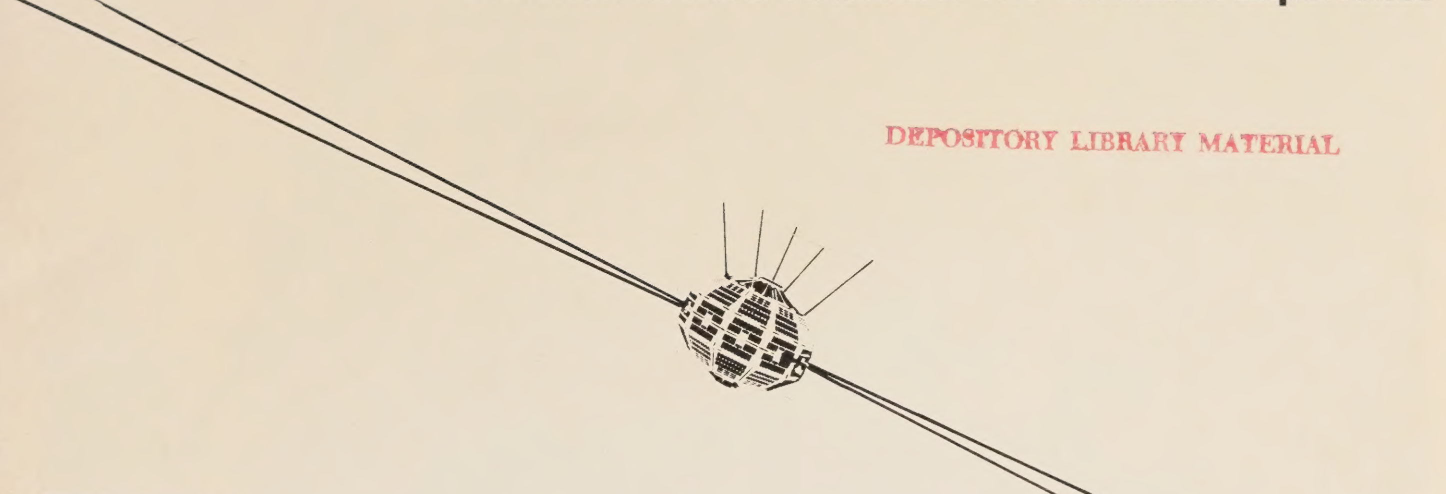

INTRODUCTION

When launched in 1976 as a joint Canada-United States venture, HERMES was the world's most powerful communications satellite. It has added new dimensions to space technology and to the practical use of satellites in such fields as medicine, education and community development.

Canada's focus on the use of space for man's practical benefit centres on two basic areas: (1) the study of the ionosphere and (2) the development of satellite technology to improve communications. From the beginning, Canada and the United States have cooperated in these areas by launching Canadian-built satellites from U.S. facilities.

Canada's first satellite, Alouette I, was launched in 1962. The information it provided about the earth's upper atmosphere was used, in part, to improve Canada's high-frequency radio communications, especially in the North. The ISIS series of ionosphere-probing satellites followed.

As space technology advanced, Canada recognized that satellite relays could provide communications services to its widely scattered population. In less than ten years it developed one of the finest domestic communications-satellite systems in the world, Telesat Canada.

The Telesat system began offering commercial satellite service in 1973. Four Anik communications satellites compose the space segment of the system. Anik A-I was the first satellite in the world to be placed in geostationary orbit for commercial domestic service. Geostationary satellites travel above the equator at the same speed as the earth rotates, so that from earth they appear to be stationary. Each of the three Anik A satellites offers total territorial coverage of Canada. Each has 12 microwave channels, and each channel can transmit a single television program or up to 960 voice circuits. Anik B, launched in December 1978, incorporates six higher frequency channels tested by HERMES, bringing its total to eighteen.

The earth segment of the Telesat system has expanded from four initial stations in 1973 to a hundred in 1978. Using a unique system of computer controls, the Telesat system can position and hold each satellite precisely on station. This has enabled the Canadian system to become the first domestic one to use less-expensive fixed non-tracking communications earth stations.

ALOUETTE I

Higher still and higher,
From the earth thou springest
like a cloud of fire;
The blue deep thou wingest,
And singing still dost soar, and soaring ever singest.
The Lark, PERCY BYSSHE SHELLEY

Canada's first space satellite, Alouette I, was placed in a circular orbit at an altitude of 1,000 kilometres on September 29, 1962. It was designed and constructed by the Canadian Research Telecommunications Establishment of the Defence Research Board * and launched from the National Aeronautics and Space Administration's (NASA) Western Test Range in southern California. Its mission was to gather information on the physical properties of the ionosphere.

The ionosphere contains electrically charged ions and electrons, which affect long-distance radio transmission. This upper atmosphere has daily and seasonal variations; and disturbances in it make long-range high-frequency radio communications difficult and sometimes impossible. Such disturbances are particularly frequent and unpredictable in the region above northern Canada, where they are visible as the aurora borealis. For Canada, one of the practical benefits of a better understanding of the ionosphere is an improved ability to bring dependable radio communications to the people spread thinly throughout the vast North.

Before Alouette I was launched, ground-based balloons, rockets and satellite-borne sensors had provided information about some features of various regions of the atmosphere. Alouette I contributed the first global information about the upper regions of the ionosphere. It performed four kinds of measurements. The main one sounded the ionosphere with radio waves. This produced a kind of radar map from above the ionosphere, which was complemented by similar studies from the ground. The equipment included two special antennas measuring approximately 46 and 23 metres, the longest antennas that had ever been flown on a space vehicle. They were stored rolled up inside the spacecraft and deployed once the vehicle was in orbit. The antenna design was later adopted for many U.S. space vehicles. The satellite also measured cosmic

*Now Communications Research Centre, Department of Communications.

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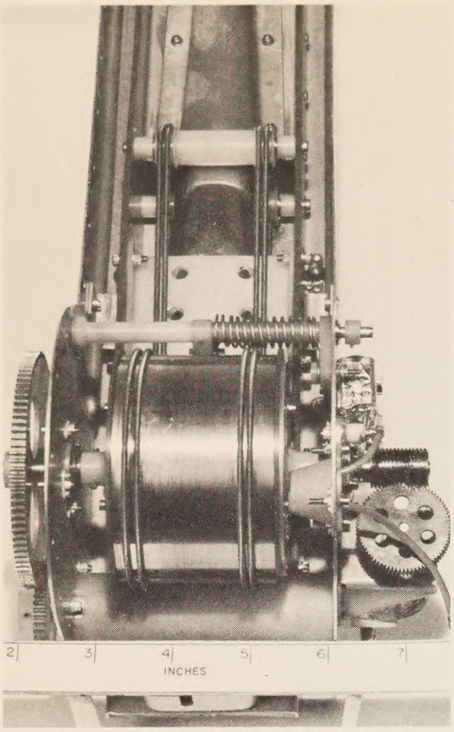

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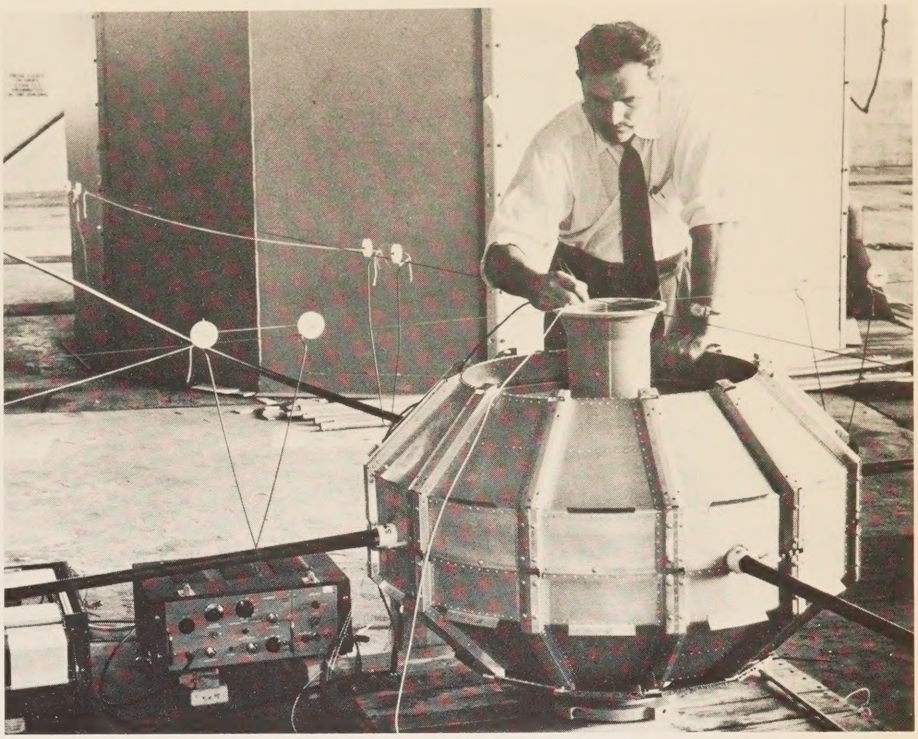


Alouette I, launched in 1962, had two antennas. Each consisted of two poles extended at right angles to one another. Each pole was stored as a tape on a spool (left) during launching. In space, as the tapes unwound, their edges curled tightly together to form semi-rigid tubes. The antennas, shown in tests (right), measured 46 and 23 metres from tip to tip. Later Alouette and ISIS satellites had 73-metre antennas.

noise, listened to low-frequency radio noise and counted the charged particles surrounding it.

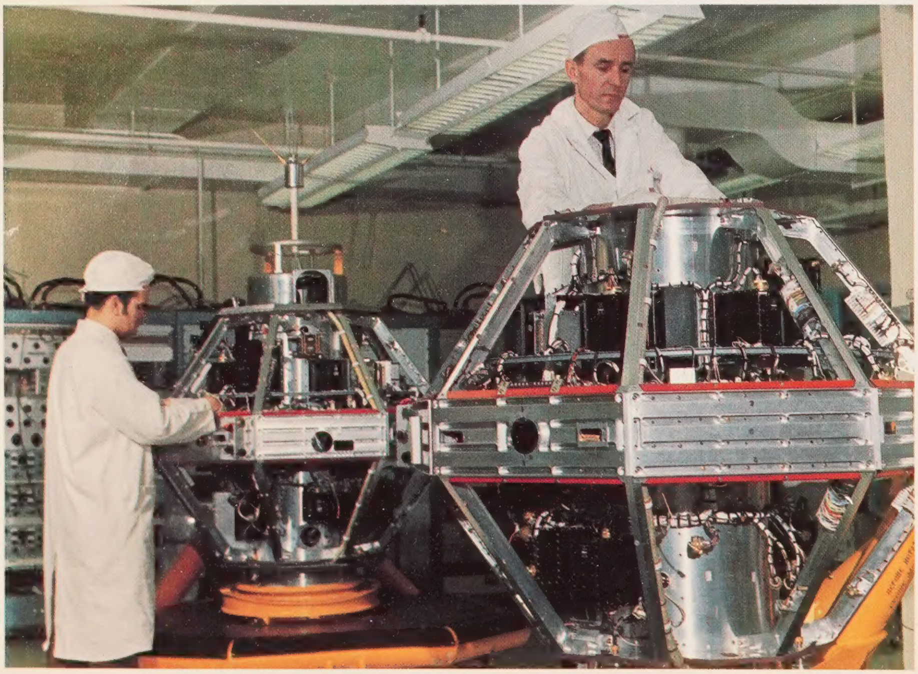
At a time when most satellites had a life of only a few months, Alouette I was designed for an expected life span of about one year; it lasted ten. Its measurements of ionospheric behaviour almost spanned an 11-year cycle of solar activity.

ISIS

Isis, the Egyptian Queen of Heavens, divided the earth from the heavens, showed the stars their paths and ordered the course of the sun and the moon.

The success of Alouette I led to an agreement between Canada and the United States to build and launch a series of International Satellites for Ionospheric Studies (ISIS). The United States agreed to launch up to four satellites from the NASA Western Test Range; Canada designed, developed and constructed the satellites. The main Canadian subcontractors were RCA Limited of Montreal (now Spar Technology Limited) for electronics and SPAR Aerospace Products Limited of Toronto for the structure.

The primary objective of the ISIS program was to make comprehensive measurements over a range of heights and latitudes in the ionosphere. Alouette II, originally built as a



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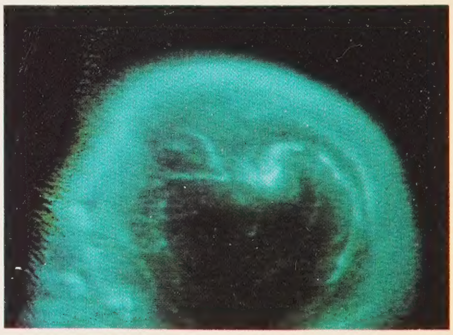
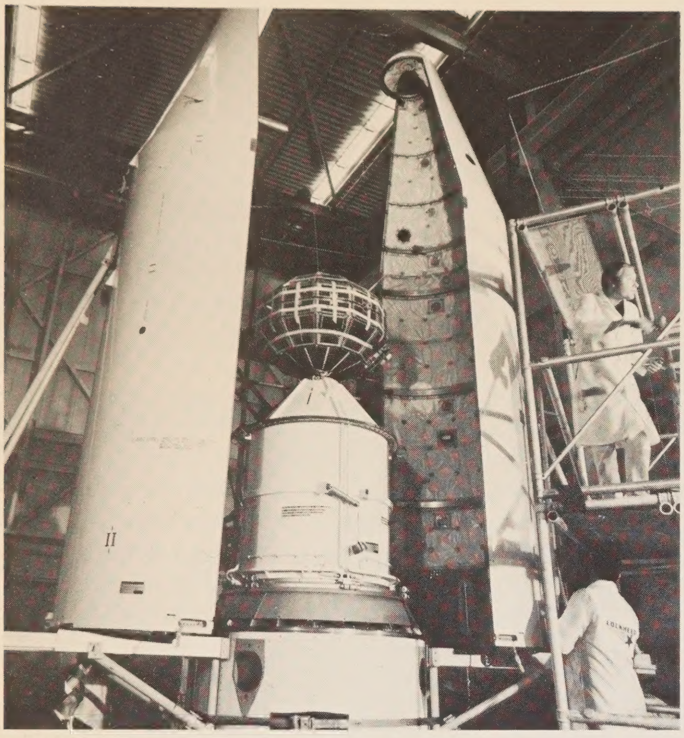


University of Calgary

ISIS II (left) was the most advanced satellite in the Canada-United States ionosphere-probing program. Its Scanning Auroral Photometer took this picture of the aurora borealis as seen from above the polar cap. When the picture, which spans all 24 time zones, was taken, it was midnight at the bulge. The green emissions are from oxygen; the blue, from ionized nitrogen.

NASA



In 1965 Alouette II, part of the ISIS series, rode into space, atop the United States' Explorer XXI, aboard a Thor-Agena rocket. Here, a prototype is fitted into the nose cone.

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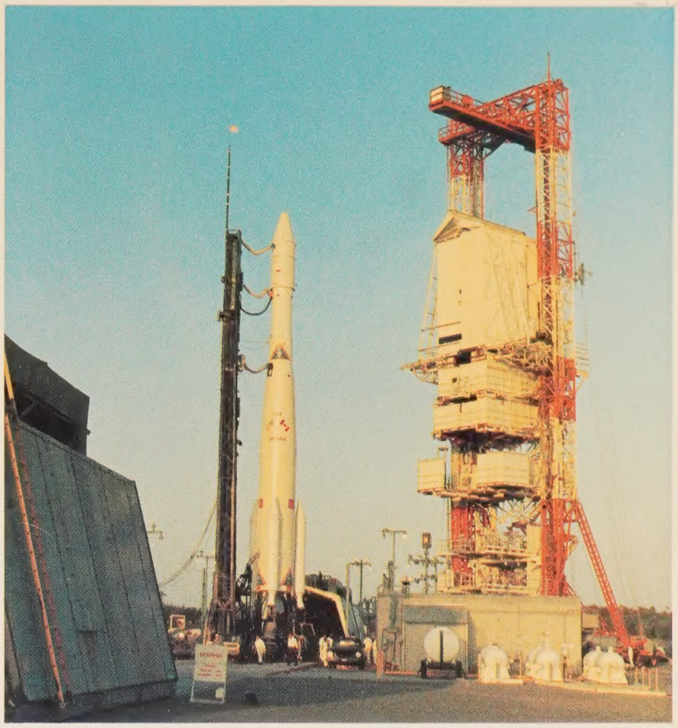


The United States provided rocket and launch facilities for the ISIS series; Canada provided the satellites. This Delta rocket was used to launch ISIS II in 1971.

back-up model for Alouette I, was modified and reconstructed to conduct five types of ionospheric measurements. It was placed in an elliptical orbit with a 515-kilometre perigee (closest point to earth) and a 2,900-kilometre apogee (farthest point from earth). Alouette II and the U.S. ionospheric satellite, Explorer XXI, were launched on November 29, 1965. Alouette II remained operational for nearly ten years.

The next in the series was the more sophisticated ISIS I. It was launched on January 30, 1969, and is still working. It was placed in an elliptical orbit ranging from 575 to 3,315 kilometres. It measured ten phenomena, including radio propagation, radiation and energetic particles.

On April 1, 1971, ISIS II was launched into a near-circular orbit with a 1,423-kilometre apogee and a 1,356-kilometre perigee. As the most advanced ionosphere-probing satellite, it made 12 types of measurements — at that time, the largest number ever made by a single space vehicle. It continued the research of previous satellites and added measurements of light radiation in the upper atmosphere. This enabled scientists to piece together the first pictures of the aurora borealis as seen from above.

The missions of Alouette I and II are now completed; those of ISIS I and II extended through 1979. Specialized ISIS projects were carried out at universities, such as the University of Calgary in Alberta, and in industries, such as the Aerospace Products Division of SED Systems Limited, Saskatchewan.

INTELSAT

In 1964 Canada joined ten other nations in the first agreement for an international communications system employing satellite technology, INTELSAT. This international consortium was created to own and operate a global commercial communications network using satellites stationed over the Atlantic, Pacific and Indian oceans. Its "Early Bird" satellite, launched on April 6, 1965, was followed by the INTELSAT II, III, IV and IV-A series. INTELSAT now has 101 member nations and 163 stations in 88 countries.

Teleglobe Canada, a Crown corporation, is Canada's INTELSAT carrier. It operates a worldwide network, which includes both communications satellite circuits and submarine cables. Teleglobe has three satellite earth stations—two at Mill Village, Nova Scotia, and one at Lake Cowichan on Vancouver Island. These are linked to overseas terminals by INTELSAT IV and IV-A satellites. The Mill Village No. 1 earth station was built as an experimental station by the Department of Transport in 1965. The Mill Village No. 2 station began operation in 1969; the Lake Cowichan station, in 1971. A station in the Laurentians north of Montreal is to become operational in 1979.

Teleglobe's dramatic use of the INTELSAT Global Satellite System made the 1976 Olympic Games in Montreal the most widely viewed event in history. Teleglobe installed a transportable earth station that used two simultaneous television channels to transmit approximately 800 hours of Olympic television programming from Canada to Asia, Europe, Latin America and Africa.

TELESAT CANADA

Canada's extensive territory, harsh climate and thinly scattered northern and western settlements have created special communications needs, and space technology has helped meet them. The achievements of Alouette and the ISIS scientific satellites, along with Canada's early participation in the experimental and commercial development of

INTELSAT, pointed to the value of satellites for enhancing domestic communications in remote locations. In 1968 the federal government decided to develop a domestic satellite communications system in order to further Canada's growth, prosperity and unity.

Telesat Canada was incorporated by an Act of Parliament on September 1, 1969. Telesat is a unique commercial venture. It is neither a Crown corporation nor an agent of government, but an enterprise whose ownership is shared by the Canadian telecommunications carriers and the federal government.

Telesat's purpose is to establish and operate a commercial system of satellite communications to serve all points in Canada, both in the northern regions and in the south. In 1978 it added an Anik B geostationary satellite to the three Anik A satellites already in space and brought its total number of communications earth stations to 100.

The Telesat system has a reliability factor of better than 99 per cent. It provides such service as global television relay with local-area television distribution, multiple and single circuit telephone service, computer-data transfer, Teletype, facsimile and other forms and combinations of electronic information. Its major customers are the Trans-Canada Telephone System, Bell Canada, and the Canadian Broadcasting Corporation. The CBC uses five channels to provide nationwide English and French network programming, live coverage of House of Commons debates and program assembly.

ANIK A

Anik, in the Inuit (Eskimo) language, means brother.

Canada's commercial domestic communications satellites are called Anik. Those in the A series are interchangeable: each makes 12 microwave channels available throughout Canada. (Each channel can carry one television program or 960 voice circuits.) All were placed in orbit from Cape Canaveral by three-stage Delta rockets provided by NASA. Anik A-I, launched on November 9, 1972, was the world's first domestic communications satellite to be placed in a geostationary orbit. Anik A-II and Anik A-III were orbited in April 1973 and May 1975. As in-space back-up for Anik A-I, they assured reliable, uninterrupted service and met requirements for increases in service. Today, Anik B is the primary operational satellite, and Anik A-III provides back-up and additional channel capacity.

Anik spacecraft are similar to the U.S.-built INTELSAT. They carry Canadian-built components and were specifically designed and built for Canadian domestic service by Hughes Aircraft Company of California. SPAR Aerospace Products Limited of Toronto and Northern Electric Company Limited of Lucerne, Québec, (Northern Telecom) were major Canadian sub-contractors to Hughes Aircraft.

The Anik A satellites have critical orbital speeds of 11,062 kilometres per hour. They are positioned 36,000 kilometres above the equator at 104°, 109° and 114° west longitude. Each is about 180 centimetres in diameter and 340 centimetres high. Each weighed approximately 570 kilograms when it was launched.

The design and space life of an Anik satellite is seven years. At present rates of consumption, fuel reserves for Anik A-I, II and III are estimated to be sufficient for operational capacity until 1980, 1981 and 1983 respectively.

NASA

In 1972 Anik A-1 became Canada's first commercial domestic communications satellite.

TELESAT TECHNOLOGY

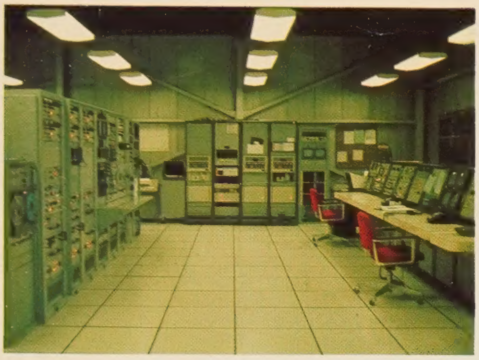
An Anik satellite "sees" all of Canada, instantly and reliably. It can connect two or more stations regardless of their locations in Canada. In the case of television, it provides point-to-multipoint service with no limit on the number of receivers.

Satellite communications networks are similar to ground microwave relay systems, but their relay stations are in outer space. A communications satellite receives microwave signals transmitted from an earth station; it amplifies them and retransmits them to receiving stations on earth. These in turn send the signals out over local lines.

The Anik A satellites operate in the 6/4-gigahertz (GH$_z$) frequency bands. Signals transmitted from the ground are received by the satellite in the 6-GH$_z$ (six billion cycles per second) band and retransmitted to the ground on frequencies in the 4-GH$_z$ band. Reliable service is guaranteed by the ability to switch operation from one of a satellite's 12 microwave channels to another. Should an Anik satellite cease operations, earth stations can realign their antennas to re-establish service using a back-up satellite.

The power of 6/4-GH$_z$ signals has to be kept relatively low so that they don't interfere with ground-based relays of long-distance telephone calls, television programs and data. More powerful signals can be sent in the 14/12 GH$_z$ bands, which are not used by existing ground communications. Anik B is the first Telesat satellite to use the higher frequency channels in addition to the 12 current ones.

Telesat



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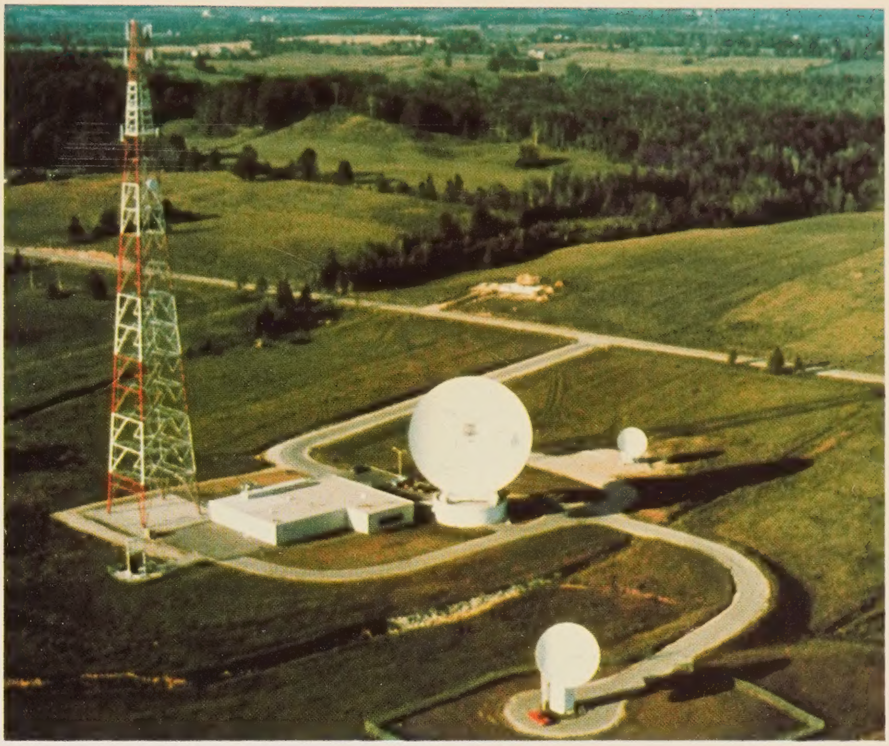

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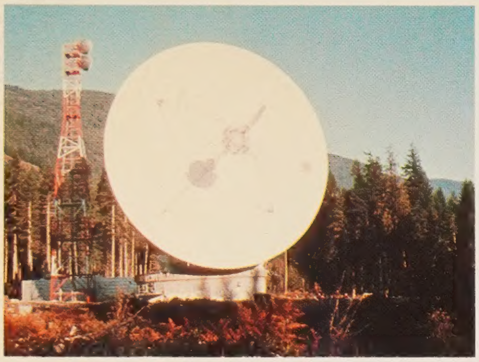

Telesat's two control stations at Allan Park, Ontario, (right and top left) and Lake Cowichan, British Columbia, (bottom left) have 30-metre antennas. The three smaller antennas at Allan Park provide tracking, telemetry and command functions. The satellite control system developed by Telesat has been used in the United States and Indonesia.

Twenty thousand silicon solar cells mounted on the body of the spacecraft provide the power for the electronic systems in the Aniks. In addition, batteries maintain full power when the moon or the earth comes between a satellite and the sun.

Using a new radio-beam system and computer controls, the Telesat System holds the position of each satellite within a tolerance of 0.05 degree latitude and longitude. All data processing required for launching, satellite manoeuvres and station-keeping are performed on Telesat's mini-computers at the Satellite Control Division in Ottawa.

The ability to position and hold satellites precisely on station has also saved money. It enabled the Canadian system to become the first in the world to use less-expensive fixed non-tracking communications earth stations. Previous systems required earth stations capable of following the deviations of a satellite from its assigned position. Only three of Telesat's earth stations have tracking antennas. They are used during launch missions and for housekeeping manoeuvres. Two are at Telesat's main location at Allan Park, 120 kilometres northwest of Toronto; the other is at Lake Cowichan, British Columbia.

Telesat Canada's network of 100 earth stations includes installations of widely varying size and purpose. The two control stations at Allan Park and Lake Cowichan have 30-metre antennas. They are heavy route stations, fully staffed 24 hours a day. They distribute network quality television and radio programming. A high-density service links Vancouver and Toronto with two-way telephone circuits, and a medium-density message service links various northern stations to the southern ground-based message network through Allan Park.

Stations with 10-metre antennas carry network television and northern communciations; those with 5-metre antennas handle remote television reception and message service.

Transportable, semi-permanent earth stations, called Anikom, have been developed to meet the demand for telecommunications services in remote locations. Anikom stations have 4-metre antennas and weigh 953 kilograms, complete with shelter. They can be moved by aircraft, train or truck and assembled within a few hours. They provide voice, facsimile, Teletype and data services.

Another development is "Frontier TV Service". It brings radio and television to small communities in isolated locations that are not yet included in the national networks. A frontier station capable of receiving one of the three CBC-TV channels can be leased at a cost of $14,000 per year. The first stations were in the Yukon. James Bay now has some, and more are planned for Saskatchewan, British Columbia and the Northwest Territories.

Over the next five years, the Northern Communications Assistance Program plans to provide basic local and long-distance telephone service in 28 of the remotest communities of the Northwest Territories. The program will be established by Telesat Canada. The federal government initiated the program and provided $9 million to help fund it.

Telesat's system has established Canada as an internationally-acknowledged leader in domestic communications via satellite. The United States' Western Union WESTAR domestic satellite communications system was modelled on Telesat's satellite-control-system design approach, as was the Indonesian PALAPA system. The planned Brazilian system will also be patterned on Telesat's controls.

Telesat

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Telesat

Telesat's Anikom earth stations (opposite page) come in easily-transported sections. They have 4-metre antennas and can be assembled in a few hours. The permanent earth stations span the nation. Those above are at Resolute, Northwest Territories, (top), Fort Chipewyan, Alberta, (middle) and Fort Severn, Ontario, (bottom).

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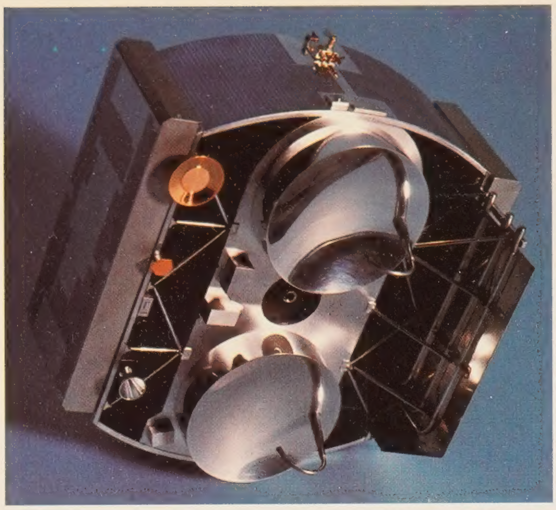

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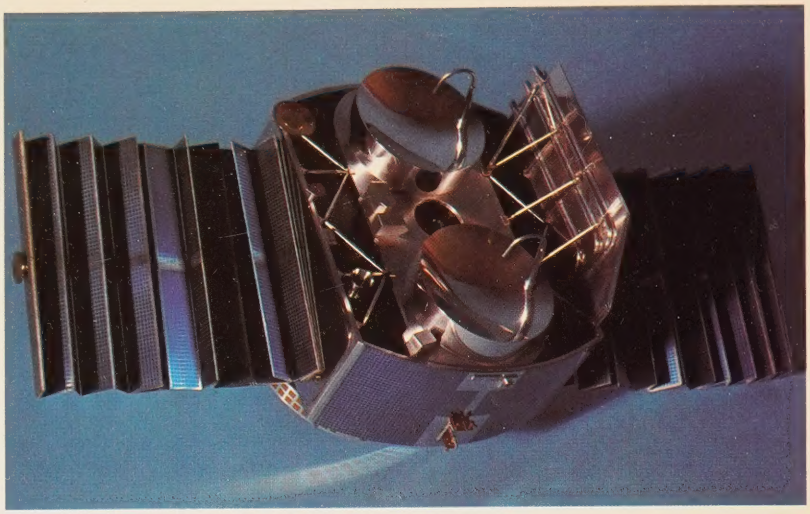

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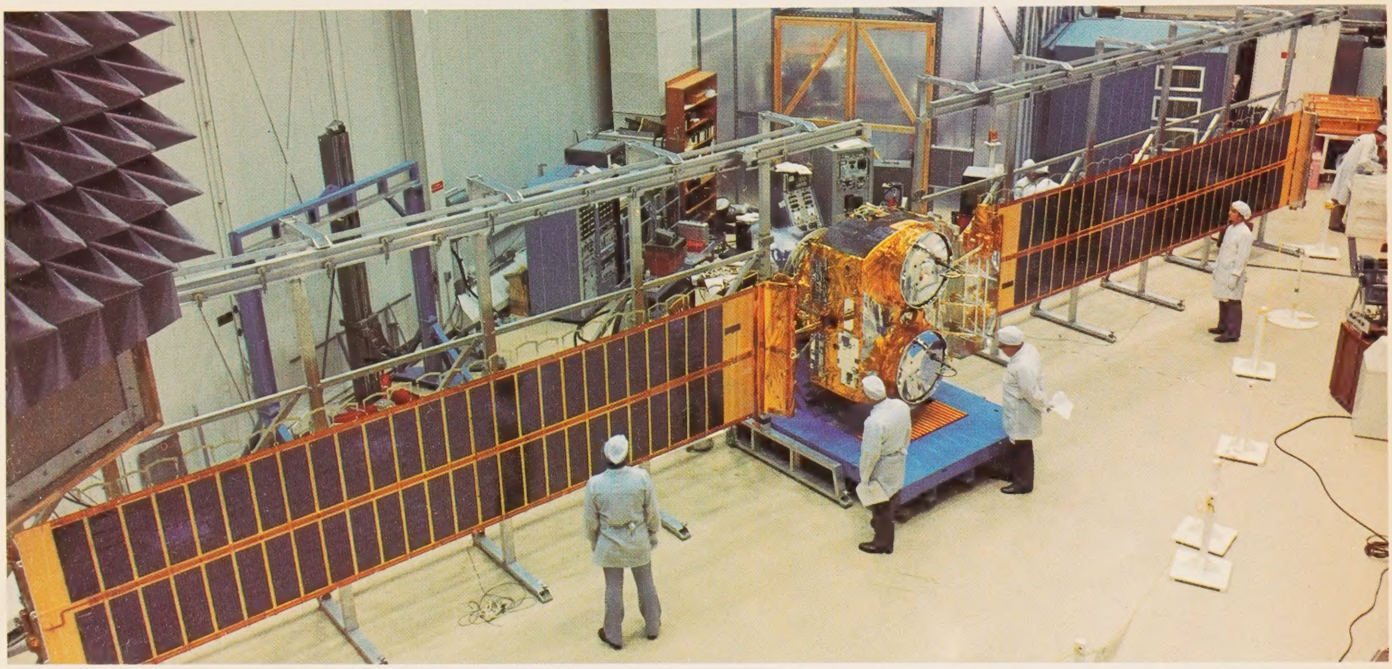

HERMES was a compact bundle (top left) when it was launched in 1976. Once in space, its arrays or sails unfolded accordion-style (top right). The arrays (bottom) have 27,000 solar power cells, which provide 1.2 kilowatts of power. The two large discs on the body are antennas.

HERMES

Hermes was the son of Zeus. He appeared in the Odyssey *as the messenger of the gods. In Greek mythology he wore winged boots and carried the caduceus, the herald's staff, which was his messenger's symbol. Hermes is also the name of a minor planet that orbited within 780,000 kilometres of earth in 1937.*

HERMES is the world's most powerful communications satellite. In April 1971, Canada's Department of Communications (DOC) and NASA agreed to develop it in order to conduct a variety of technical and social experiments in such fields as telemedicine. It was originally called the Communications Technology Satellite (CTS) and was to have a two-year mission life. Launched from the Kennedy Space Center on January 17, 1976, it remained operational until December 21, 1979.

DOC was responsible for the overall management of the project. It designed and built the spacecraft at the Communications Research Centre (CRC) near Ottawa. The cost to Canada was about $60 million, and 80 per cent of the industrial contracts, by value, went to Canadian industry. NASA provided an experimental, high-powered (200-watt) transmitting tube, conducted pre-launch testing and launched the vehicle. Its costs were $11.4 million for the HERMES program and $10.8 million for the launch vehicle. The European Space Agency also provided several components.

The over-all objective of the HERMES program was to advance the technology for space and ground components of satellite systems that use high-radiated radio frequency power. Toward this aim, HERMES used the new 14/12-GH_z frequency bands, which are reserved for broadcast satellites. An added Canadian objective was to develop advanced component and subsystem capacity in Canadian industry, both for Canadian use and for export.

A Delta model 2914 vehicle launched HERMES into a geostationary orbit at 116° west longitude, just west of South America. The experimental spacecraft is 188 centimetres high and 183 centimetres in diameter. It weighed 674 kilograms at launch. It had two channels, each of which covered a

ground area approximately 965 kilometres wide.

The HERMES design centred around three major advanced technology subsystems:

(1) NASA's 12GH$_z$ TRAVELLING WAVE TUBE (TWT) AMPLIFIER delivered output power of 200 watts at approximately 50 per cent efficiency. Tubes in conventional satellites deliver roughly 6 watts at 30 per cent efficiency.

(2) A pair of lightweight DEPLOYABLE SOLAR ARRAYS (sails), studded with 27,000 solar power cells, provided 1.2 kilowatts of power to the spacecraft. The solar arrays were stowed accordion-style inside the spacecraft during launch and unfurled once the satellite was on station. Extended, each is roughly three times as long as the diameter of the spacecraft body. Their total span was 16.5 metres. Each extended sail had a sensor that controlled a drive mechanism and enabled the sail to track the sun.

(3) A THREE AXIS STABILIZATION SYSTEM kept the satellite fixed with its antennas pointed earthward (within 0.2 of a degree of variation). The solar sails independently tracked the sun. Conventional satellites are spin-stabilized.

The earth segment of the HERMES program was as important as the satellite. Small, moderately-expensive earth terminals functioned near the users. There were 18 stations with one- and two-metre antennas and two self-contained, transportable stations with three-metre antennas. HERMES's high power transmission could also send colour television to simple, low-cost ground receivers. The smaller stations received audio-broadcasting and occasionally television, as well as two-way voice communications. The larger terminals transmitted and received television, voice and data.

HERMES EXPERIMENTS

Canada and the United States began their original program of experiments in April 1976. They used the satellite on alternating days. In Canada, 30 organizations conducted 15 technical and 22 social experiments. Universities, industries, broadcasters, native associations and federal and provincial governments worked in such areas as telemedicine, tele-education, community interaction and administrative services. Because the satellite functioned beyond its expected life, some new experiments were added.

Technical experiments included those by Telesat and Bell Canada designed to evaluate the transmission capabilities, ground-station portability, reliability and maintenance requirements of advanced technology satellites. The Communications Research Centre tested the performance of small earth terminals in order to help plan future systems.

The Canadian Broadcasting Corporation (CBC) investigated broadcast-signal reception in large cities. HERMES's higher frequency band permitted interference-free satellite communications directly to and from a metropolitan centre. Small receiving antennas were located, for example, on the roofs of buildings. This reduces costs by eliminating the need for terrestrial relays to and from earth stations located away from major population centres. The CBC also tested HERMES's technical suitability for expanding radio services in small communities.

L'Institut de Recherche of Hydro Québec employed the HERMES system for precise control of remote power stations in northern Québec. It used telephone data transmission to synchronize clocks within 20 microseconds. According to Dr. Pierre Girard, the institute's program director, this level of precision is particularly significant in the event of a power failure. It allows the exact sequence of events — before and after the failure — to be recorded within a millisecond. Dr. Girard also foresees using satellites to communicate with temporary remote locations during such projects as constructing dams and installing new lines.

TELEMEDICINE

The goal of the HERMES telemedicine pilot projects was to improve the efficiency and capability of the overall Canadian health care system, particularly in remote locations.

Medical staff from Queens University and the University of Western Ontario make consulting visits to Moose Factory General Hospital, but specialists, such as neurologists, rarely go. A University of Western Ontario HERMES experiment made instant consultation possible by linking the London, Ontario, Health Science Centre to the Moose Factory hospital, as well as to the Kashechewan Nursing Station on James Bay. Experiments with transmitting x-ray images allowed doctors in London to diagnose a gastric ulcer using television fluoroscopy. Dr. Lewis S. Carey, a professor at the University of Western Ontario, reported, "It was the first time, to my knowledge, that such a diagnosis has been made by satellite." In another instance, a neurologist in London diagnosed and prescribed treatment for a public health nurse in Moose Factory, 1,125 kilometres away. The nurse had been reluctant to take the time to go south to see a specialist. The remote diagnosis determined that the problem was not neurological, and minor surgery at Moose Factory corrected it.

Memorial University of Newfoundland broadcast a continuing medical education program for doctors, nurses and teachers and conducted community health programs in four remote hospitals—St. Anthony and Stephenville on the island and Labrador City and Goose Bay in Labrador.

With the HERMES satellite, the continuing education project went beyond services available with educational television. It provided instruction via one-way video transmission, plus student involvement through two-way audio channels. "The ability to interact with a tutor is the essence of a good education program," according to Dr. M. House, a professor and assistant dean at Memorial University Hospital. The community health programs featured communication among remote locations over a "giant party line". A resource group consisting of a nutritionist, a dietician, a physician and a social worker led discussions on such topics as juvenile diabetes and pre-natal care. "Tele-visits" allowed patients in St. John's to see and speak to relatives and friends in remote areas.

The Memorial University projects demonstrated the emotional as well as the educational value of satellite communications. Dr. William Squires, of Stephenville, noted that the education program allowed physicians in the larger centre to keep in touch with the medical problems at the periphery and eliminated his need to regularly spend several days at the urban medical centre for continuing education. For Mrs. Pat

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HERMES experiments in telemedicine (left) linked doctors and nurses at remote northern hospitals to specialists in urban centres, such as London, Ontario. One in tele-education (right) allowed Carleton University, in Ottawa, and Stanford University, in California, to share graduate-level engineering courses. This class originated at Carleton.

Dunck, a nurse at St. Anthony, the education was valuable, but "it was really helpful to know that we were not nurses isolated at the end of nowhere, and that people were interested in sharing with us."

TELE-EDUCATION

L'Université du Québec is decentralized in order to provide the widest possible access to higher education. Its regional centres are linked through a telephone network for teaching, document exchange and management purposes. Its "Omnibus Network" HERMES project demonstrated how satellites may expand communications in the 1980s.

In another tele-education project, Carleton University in Ottawa and Stanford University in California shared classes on a daily basis over a six-month period. In contrast to correspondence courses, radio networks or public television, the Carleton-Stanford experiment allowed two-way course sharing. The two universities exchanged graduate-level engineering courses, providing academic credits to students at both ends of the system. Dr. Donald George, a Carleton professor of engineering, believes the experience can be expanded to include beaming instructional television from urban universities to remote locations and from a main campus to students throughout urban areas. According to Mr. Kenneth Down of Stanford's engineering department, the next step in the United States will be a proposal for a national satellite distribution system involving a consortium of 17 American universities.

Stanford was also involved with l'Université de Montréal in a bilingual colloquium that utilized simultaneous translation. In the opinion of both participating groups, the success of this event indicated the potential for future international telecolloquia on a much broader scale. Mr. Jean Cloutier of l'Université de Montréal also sees a potential for communication among Canadians who speak different languages.

INTER-COMMUNITY EXCHANGES

The "Saskébec Education-Culture Exchange" HERMES project involved interaction between two Canadian Francophone communities — Zenon Park in northern Saskatchewan and Baie St. Paul, 3,000 kilometres away in Québec. The project was initiated by Dr. Bernard Wilhem of the University of Regina to alleviate some of the isolation of Zenon Park, a Francophone village of 400 people.

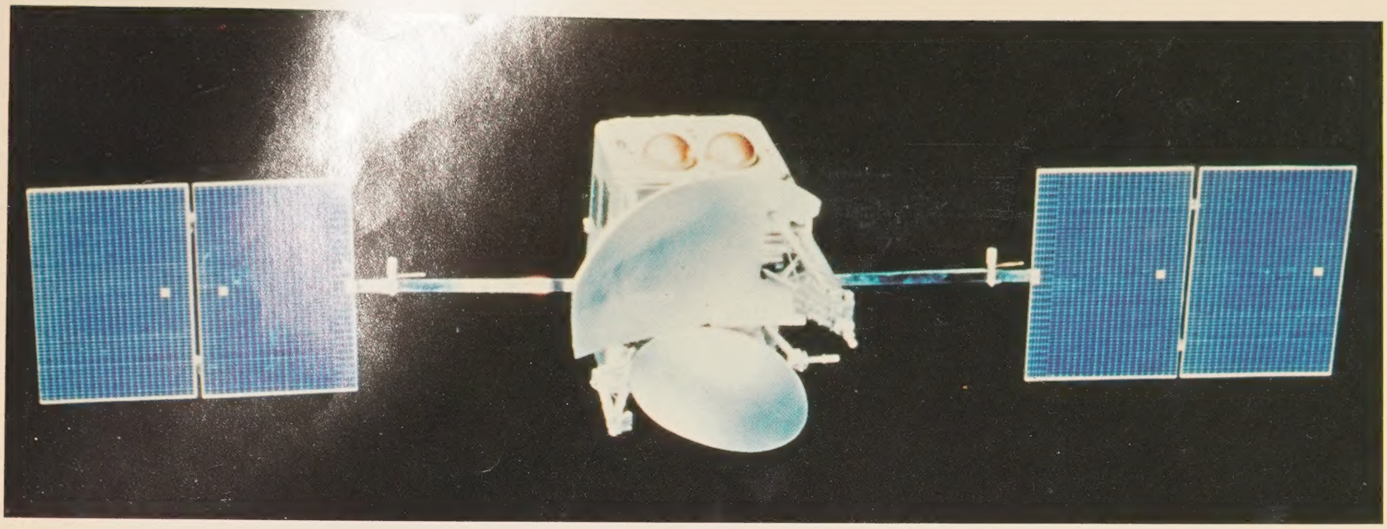
Exchanges between Zenon Park and Baie St. Paul included education projects, information about the historical development and geographic location of each community, agricultural perspectives and senior citizen activities. In addition to learning about others, each community rediscovered itself by explaining its life to its distant counterpart. Dr. Brian Rainey, of the University of Regina, believes that Saskébec prompted a renewed pride in the French language in Zenon Park as its citizens discovered that French could be a language of communications with the outside world.

Michel de Celles, Québec's Saskébec director, foresees using future communcations satellites to support and improve the teaching of French in remote locations. Québec will use the recently-launched Anik B for a northern Québec pilot project to educate native and non-native people in remote regions and to conduct interchanges among native communities.

ANIK B

On December 15, 1978, NASA launched Telesat's Anik B. It replaced Anik A-1 and A-2 in the 6/4-GH_z bands and makes twelve 14/12-GH_z channels available for commercial domestic service. Anik B weighed 923 kilograms at launch and is 1.8 metres wide and 11.3 metres high with its solar panels extended.

The Department of Communications is using its two-year lease on the 14/12-GH_z channels for a series of pilot projects expanding the HERMES experiments. The seventeen sponsors of accepted plans include native groups, universities, provincial and federal government departments and private communications carriers, such as the Trans-Canada Telephone System. A Department of Communications experiment uses small earth stations for individual home television reception in remote areas not otherwise reached by television broadcasting. Each 1.2- or 1.8-metre earth station is directly connected to a television set.



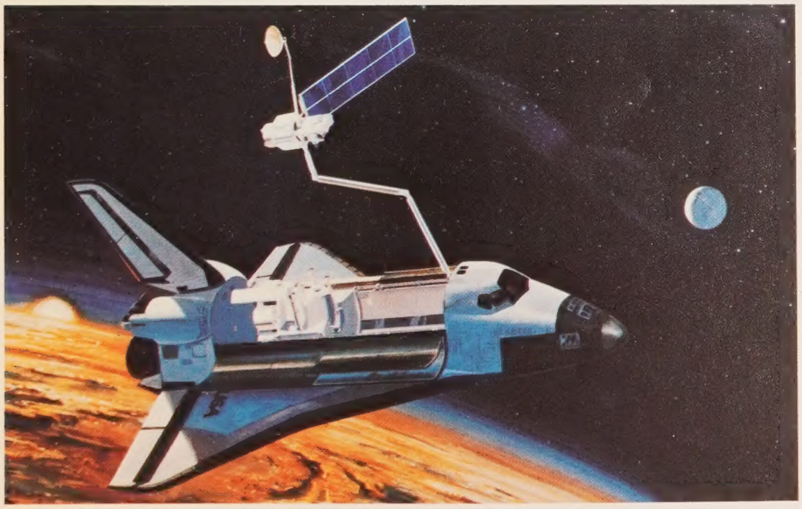
Anik B, Canada's newest commercial domestic communications satellite, uses technology developed by HERMES. It is the first commercial satellite to use both the 6/4-GH$_z$ and the 14/12-GH$_z$ bands.

SATELLITES FOR THE 1980s

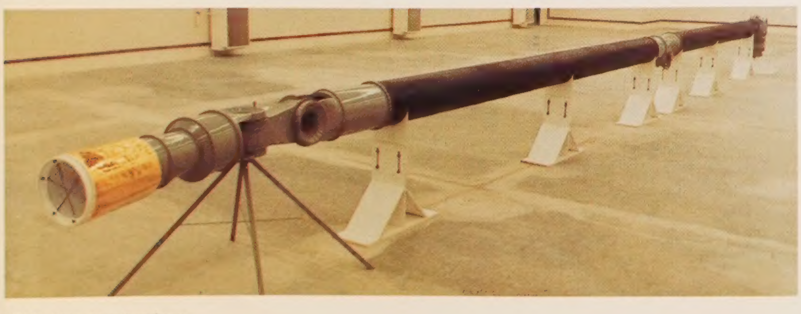
The Anik C and Anik D series are planned for commercial operation in the Fixed Satellite Service in the 1980s. Telesat's projected expenditure of $400 million over the next ten years on the Anik C series includes three satellites scheduled for launch between 1982 and 1984. Their 14/12-GH$_z$ transponder channels will have characteristics similar to those of Anik B. The prime contract Anik D series, which will replace the 6/4-GH$_z$ channels of Anik B and the Anik A series as they wear out, has been awarded to SPAR Aerospace Products.

The Anik C and Anik D satellites are designed to be placed in orbit by either NASA Delta rockets or the NASA Space Transportation System (STS), better known as the Space Shuttle. Telesat will become one of the first commercial users of this new mode of space cargo delivery if it is ready in time for the launching of Anik C-1 in 1982.

The Space Shuttle orbiter is a combination aircraft and rocket spaceship. It will transport people and equipment into space, then return to earth. Each orbiter vehicle should be able to make at least 100 such trips, greatly reducing the cost of placing future communications spacecraft into orbit. A Canadian industrial team is designing, testing and constructing the shuttle's Remote Manipulator System (RMS). The RMS is a complex, arm-like device, 15.2 metres long. It will remove a satellite or other payload from the cargo bay of the orbiter vehicle and place it in space. It will also retrieve recoverable satellites.

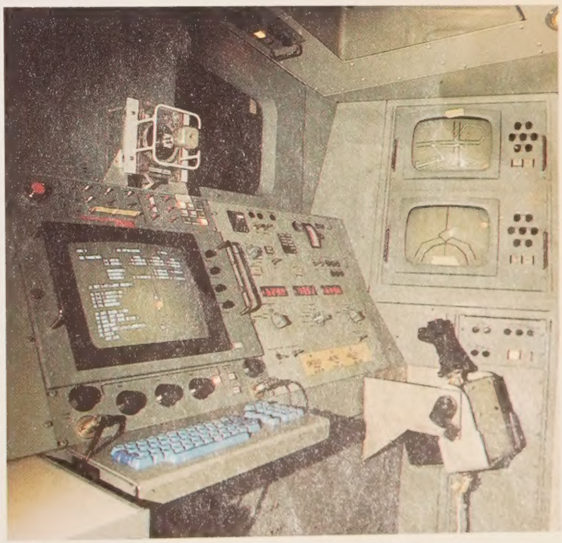


SPAR Aerospace Products



SPAR Aerospace Products

The Remote Manipulator System that will lift satellites and other cargo in and out of NASA's Space Shuttle (top left) is being designed and built by SPAR Aerospace Products Ltd., Toronto. The RMS arm, which will be too light to move its own weight under earth's gravity, will in space move objects that weigh as much as 65,000 pounds. Scientists use computer mathematical models, instead of mockups (bottom left), for most testing. The simulation of the shuttle's crew compartment (below) is used for training.



SPAR Aerospace Products

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